

# **Sat-tec....**

The leader in Low Cost TVRO



## **R2A Receiver**

### **OWNER'S MANUAL**

**Sat-tec Systems**

Div. of Ramsey Electronics Inc.

2575 Baird Rd., Penfield, NY 14526 716/586-3950



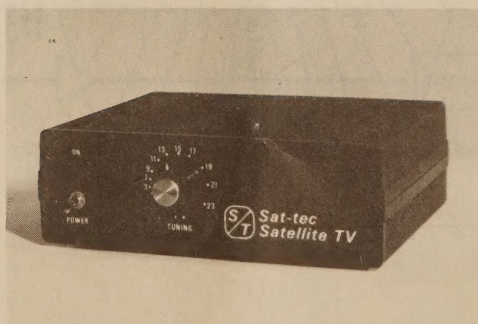


# R2A Features

---

The Sat-tec R2A is one of the most highly integrated receivers on the market today, featuring:

- \* Excellent threshold performance from "state-of-the-art" technology insures good performance from even the weak transponders
- \* Extended bandwidth demodulation for superior pictures — yet without sacrificing interference rejection
- \* Innovative single board dual conversion design eliminates inter-connections, reduces interference pickup and enhances reliability
- \* Tight tracking AFC locks in each transponder like a switch and eliminates constant fine tuning
- \* Fully frequency agile, covers the entire 3.5-4.5 GHZ range in one continuous band — usable on 12 or 24 transponder birds as well as foreign satellites
- \* Dual simultaneous sound subcarrier demodulators for maximum versatility
- \* Standard outputs compatible with VCR, monitor, or modulator
- \* Cost effectiveness second to none, making it the dealer's choice for today's competitive marketplace





# Satellite TV, An Introduction

With the advent of network television, an urgent need arose for a nationwide video distribution network. Initially films were used for distant and low-usage points and coaxial cables for high density routes. A network of microwave tower links gradually supplanted the coaxial cable and film routes until by the early 60's most populous points in the U.S. were served. In the meantime, satellite communications, an offshoot of the space program, was maturing and in the early 70's, it was apparent that it would be more cost effective to have a network of orbital satellites broadcasting to TVRO terminals than to cover the U.S. with microwave relays every 30 miles. In effect, a geosynchronous satellite was a microwave tower 22,400 miles high that could 'see' every point in the U.S. simultaneously. Geosynchronous refers to a satellite in an equatorial orbit that turns at exactly the same rate as the earth below and thus appears as a stationary point in the sky. This meant that a link now consisted of only 3 points; the ground source of signal, the satellite relay, and the ground receiving station (TVRO), and any number of TVRO's could be added. Suddenly it became bad business to build microwave relays and good business to build TVRO terminals. Intense research into Low Noise Amplifiers (LNA's), antennas and receivers has brought the cost of a TVRO down from \$100,000 in the early 1970's to under \$5,000 in 1980 — within the reach of many private individuals.

The Sat-tec R2A receiver coupled with a suitable LNA and antenna is such a system.

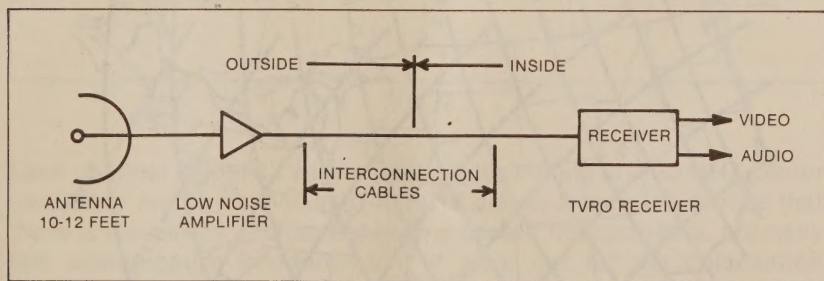


FIG. 1

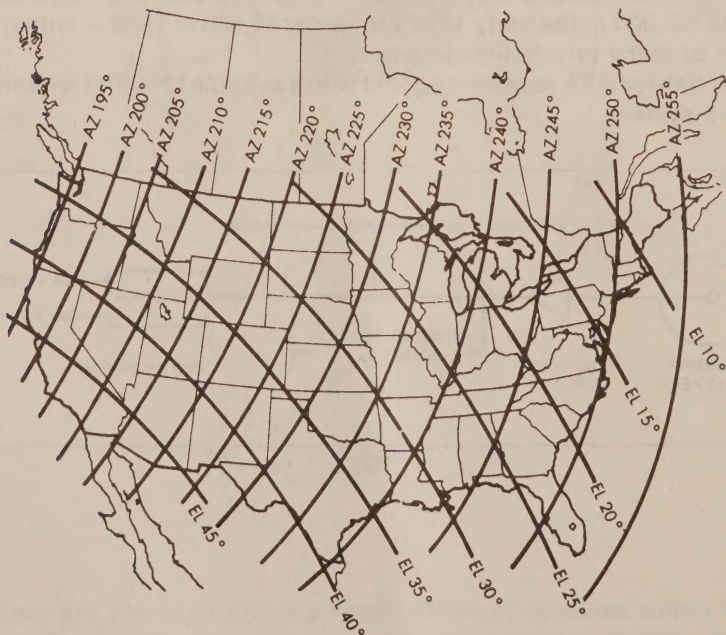


# Satellite Locating Chart

Satellite	Location
Comstar 3	87°
Westar 3	91°
Comstar 2	95°
Westar 1	99°
Anik 1	104°
Anik B	109°
Anik 3	114°
Satcom 2	119°
Westar 2	123.5°
Comstar 1	128°
Satcom 1	135°

## Azimuth and Elevation for RCA F1

**SATCOM I**  
at 135 degrees W



# How It Works

So far it looks simple, but it is not as easy as it looks. Each transponder puts out about 5 watts of power, about what a powerful battery lantern does, and this is spread out over the entire U.S.! Just imagine trying to paint the whole U.S. with 5 gallons of paint — this gives you some idea of just how weak the satellite's signal is. The reason for such a weak signal being sent from the satellite is energy and reliability, all power must come from solar panels and equipment must work for years and years — no repairs allowed up there. A careful study was made as to the most effective use of power vs. reliability vs. ground equipment and it turns out that 5 watts is optimum. It is cheaper and more practical to make the ground station more elaborate than to sacrifice satellite reliability.

A typical satellite has 24 transponder channels available, each transponder receives an earth signal, changes its frequency and retransmits back to earth. The uplink signal is in the 6 GHZ band and the downlink signal is in the 4 GHZ band. The transponder assignments look like this:

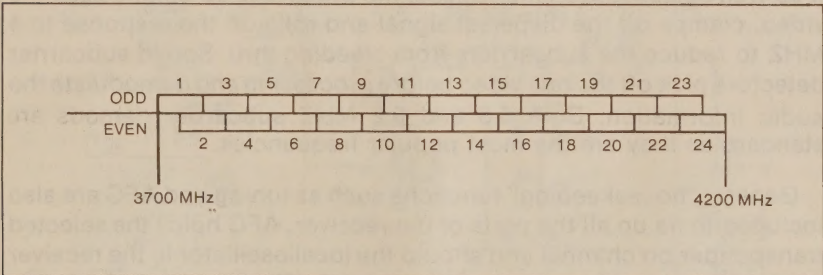


FIG. 2

Each channel is 40MHZ wide with the odds staring at 3720 MHZ center frequency and the evens at 3740 MHZ center frequency. Notice that there is frequency overlap between adjacent transponders, normally this would cause interference if it were not for the polarization difference. The vertical and horizontal polarizations, much like polarized sunglasses, allow only signals polarized in the same sense to be received, and if there are two polarization senses, twice as many signals can be sent. Receiving both polarizations requires the use of a rotatable feed horn to match the channel you want to watch with the proper polarization.

The antenna focuses the energy it receives from its entire surface into the feed horn, much like a magnifying lens can focus the sun's

energy to burn paper. The collected energy is passed on to a very special amplifier called an LNA. The LNA is a cascade of Ga As Fet and bipolar transistors arranged to provide 50 db of gain with very little noise added. Now the signal is processed and amplified enough to travel thru coaxial cable to the receiver.

The amplified satellite signal driving the receiver is at a very high microwave frequency which requires special circuitry, both critical and costly. For this reason, the signal is converted to a more managable frequency as soon as possible. The first IF frequency is 1100 MHZ, this being a good compromise for gain and image rejection. The first IF is then mixed down to a 70 MHZ second IF which is where most of the receiver gain can be found. The second IF has about 60 db of gain and a bandwidth of 27.5 MHZ, wide enough for all of the satellite's signal.

Demodulation of the signal takes place in a bandwidth-extended Phase-Lock-Loop (PLL), bandwidth extension simple means the PLL can follow wide bandwidth signals. The detected output contains all of the satellite's information, the video, subcarriers for sound and a 30 HZ dispersal waveform. Video processing circuitry produces standard NTSC video from raw video. Raw video has the dispersal waveform on it as well as being pre-emphasized, the processor de-emphasizes the video, clamps off the dispersal signal and rolls off the response to 4 MHZ to reduce the subcarriers from bleeding thru. Sound subcarrier detectors pick off the raw video before processing and demodulate the audio information. Both 6.8 and 6.2 MHZ subcarrier demods are standard as they are the most popular frequencies.

General "housekeeping" functions such as tuning and AFC are also included to tie up all the parts of the receiver. AFC holds the selected transponder on channel and should the local oscillator in the receiver drift, AFC will pull it back on. Tuning of the receiver is simple and a single turn control tunes the full 3.7-4.2 GHZ band, the tight tracking AFC gives the control a channelized feel.

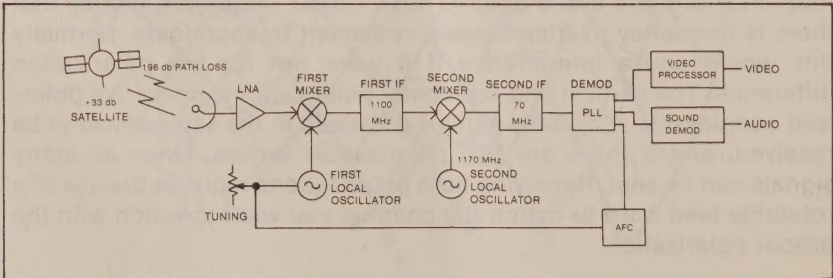
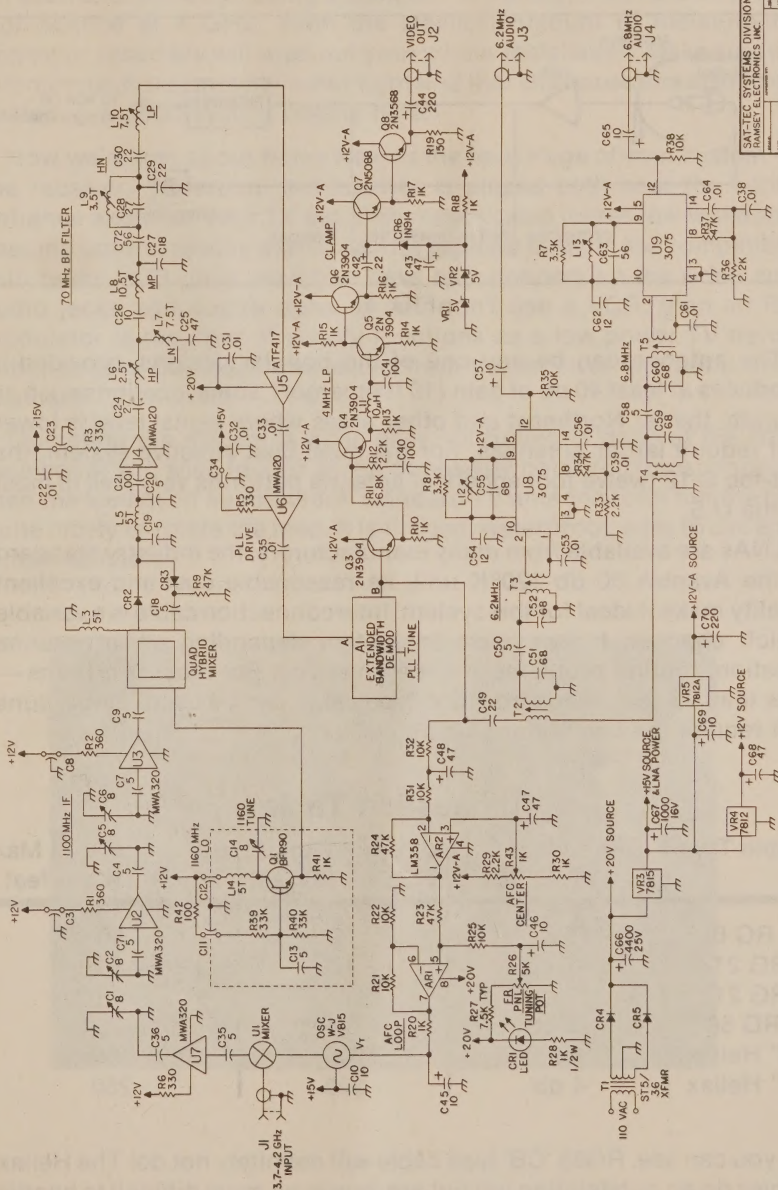


FIG. 3



The R2A, with its single board ground plane design greatly reduces connector losses, ground loops and enhances reliability to give the system the best possible operating conditions.



# Installation

Installing the R2A into a system is simply a matter of connecting cables. A typical system set-up is shown here:

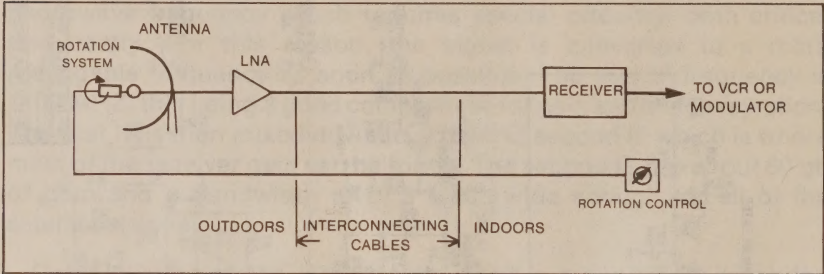


FIG. 4

The antenna can be any one of the popular designs, provided it produces at least 40 db of gain (10 ft or larger), some locations such as Florida, the far Northeast and other areas where signal level is lower will require larger antennas. For the most cost effective system, the Sat-tec S-12 twelve foot spherical antenna performs very well in most of the U.S.

LNAs are available from many manufacturers, the industry standard is the Avantek 50 db 120°K unit, its reasonable cost and excellent quality make it ideal for this system. Interconnection cable is a variable which changes from system to system depending upon antenna location, routing problems and length of run. For most short runs — less than 75 feet, standard RG-8 type cable can be used, longer runs will require the use of hardline or 'Heliax'.

## Attenuation Table

Cable Type	Attenuation per 100' @ 3GHZ	Maximum length (12db loss) feet	Recommended Max length (10db) feet
RG 8	17 db	70	60
RG 213	17 db	70	60
RG 217	12 db	100	85
RG 58	45 db	30	25
½" Heliax	6 db	200	165
⅞" Heliax	4 db	300	250

As you can see, RG58 'CB' type cable will definitely not do! The Heliax cables do an outstanding job but are, however, more difficult to handle



as well as being more expensive. If you do have to use Heliac, try to stick with the  $\frac{1}{2}$  inch size, it is far more workable than the  $\frac{7}{8}$  inch type as well as being substantially cheaper for both cable and connector ends.

A very important part of your interconnection is the connector found on each end. Although being a standard 'N' variety, they take on a new significance at 4 GHZ, even the smallest amount of moisture or improper assembly will wipe out your whole installation. Make sure all interconnections are fully water tight and that all connectors are firmly seated — a good system begins here!

Now we're just about home free, to the final stage of your system — the receiver. Preferably the receiver is placed both near the cable entrance and near your TV set. This makes cable losses low while still keeping control readily available. The receiver outputs are compatible with home VCR units, so if you have one, connect up the video and audio jacks and you're done. If you don't use a VCR, then an RF modulator is required. It simply functions as a low power TV transmitter to take the video and audio from the receiver and put it on a standard TV channel.

Operating the system is quite easy, all tuning is done at the R2A receiver. If you wish to look at the oppositely polarized transponders, then the feed must be rotated. A standard TV antenna rotor fills the bill quite nicely to rotate the feed. It is rugged, waterproof, easy to use and simple to cable.



# Receiver Controls and Connections

---

Controls and connections on the R2A receiver are very basic, non-technical persons will have no trouble hooking it up or operating it. Some hi-fi systems are more difficult!

Front panel controls:

Power switch: turns the receiver on and off - up is on.

On indicator: LED which lights up to indicate power on.

Rear panel connections:

Input jack: type 'N' female jack where 3.7-4.2 GHZ signal from LNA is connected.

Video out: RCA type female jack where 1 volt p-p video is available. This level is compatible with VCRs, monitors and most modulators.

6.8 audio: source of 6.8 MHZ demodulated sound. This subcarrier is most used on RCA birds.

6.2 audio: source of 6.2 MHZ demodulated sound. This subcarrier is most used on WESTAR birds.

LNA power (not available on all models): LNA power source, good for 15 volts at up to 150 ma. If you use this supply, it is a good idea to keep the receiver 'on' at all times, this will constantly keep the LNA warm and thus prevent moisture build up.

Line cord: connects to standard 120 VAC power. Receiver draws about 25 watts.



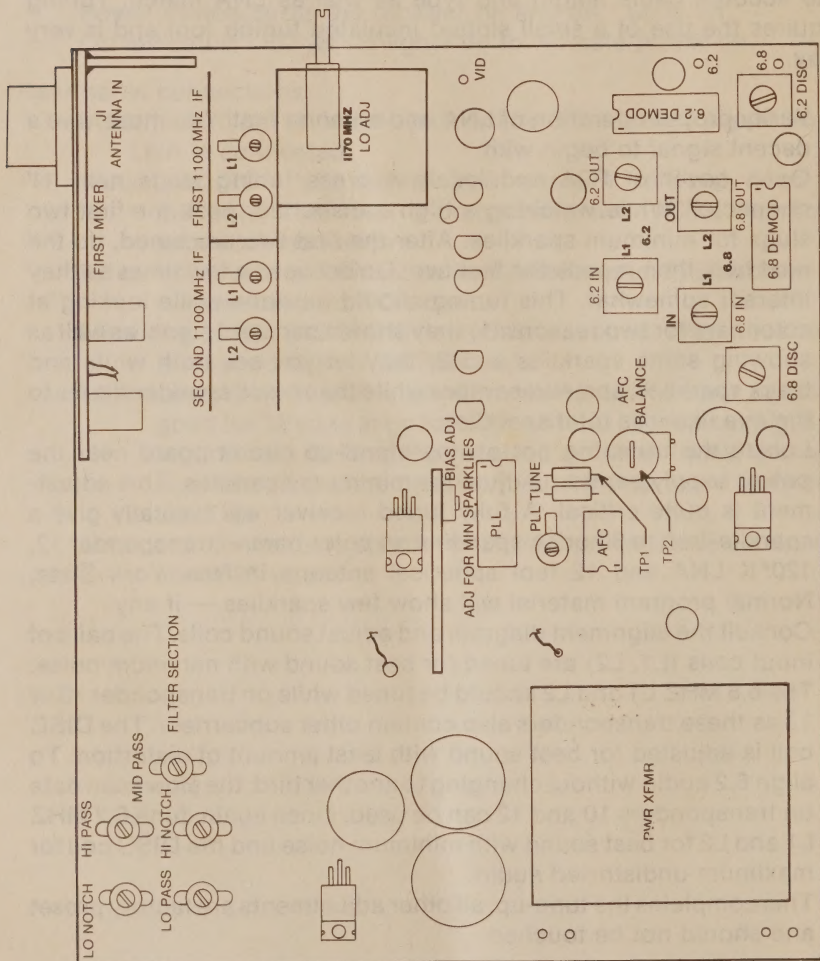
# Recommended Set-up Procedure

---

After installation of the R2A, on site alignment will usually improve picture quality. This is not a complete alignment, but rather a simple 'peak-up' to provide optimum performance as a whole system, taking into account cable length and type as well as LNA match. Tuning requires the use of a small slotted insulated tuning tool and is very easy.

- 1) Verify proper operation of LNA and antenna first! You must have a decent signal to begin with.
- 2) Open cover of R2A and locate 4 brass tuning slugs near 'N' connector. While watching a high transponder peak the first two slugs for minimum sparklies. After the first two are tuned, do the next two, then repeat the first two. Go between a few times as they interact somewhat. This tuning should be done while looking at color bars for two reasons: 1) they show a constant signal as well as showing some sparklies and 2) they let you see both white and black sparklies, sometimes more white than black sparklies looks to the eye like less total sparklies.
- 3) Locate the trimming pot on the stand-up circuit board near the power supply section. Adjust for minimum sparklies. This adjustment is quite critical. A fully tuned receiver will typically give a sparklie-free to 30 or so sparklies on color bars — transponder 12, 120°K LNA and 12 foot spherical antenna in New York State. Normal program material will show few sparklies — if any.
- 4) Consult the alignment diagram and adjust sound coils. The pairs of input coils (L1, L2) are tuned for best sound with minimum noise. The 6.8 MHZ L1 and L2 should be tuned while on transponder 10 or 12 as these transponders also contain other subcarriers. The DISC coil is adjusted for best sound with least amount of distortion. To align 6.2 audio without changing to another bird, the slow scan data on transponders 10 and 12 can be used. Once again, tune 6.2 MHZ L1 and L2 for best sound with minimum noise and the DISC coil for maximum undistorted audio.
- 5) This completes the tune-up, all other adjustments are factory preset and should not be touched.

# Layout









# List of Services - RCA F1

- 1 KTVU**  
Around-the-clock family programming from San Francisco's prominent independent television station. (KTVU-TV, Oakland/San Francisco, Channel 2.)
- 2 PTL (People That Love)**  
Combining technical excellence and quality programs to provide 24-hr. Christian entertainment. Viewing includes talk/variety, children's, drama, and specials from around the world.
- 3 WGN**  
Well-rounded programming format featuring movies, sports, specials, and syndicated programs. From Chicago's leading independent television station. (WGN-TV, Chicago, Channel 9.)
- 5 THE MOVIE CHANNEL**  
Reels and reels of movie programming. The entertainment runs non-stop from early a.m. to early a.m.
- 6 WTBS**  
An independent television station programming format comprising a wide variety of films and TV's golden oldies. (WTBS-TV, Atlanta, Channel 17.)
- 7 ESPN (Entertainment & Sports Programming Network)**  
The sports fanatic's Shangri-La, featuring 1400 NCAA events.
- 8 CBN (Christian Broadcasting Network)**  
Christian music, news, sports, children's and family entertainment presented 24 hours per day, including Ross Bagley, the world's first video deejay, plus free phone-in prayer and counseling for viewers. Programs represent 67 different sources.
- 9 USA NETWORK: SPORTS**  
Live from Madison Square Garden, its 300 sports events featuring Thursday night NBA, Monday night NHL, NCAA basketball and a wide variety of sports spectaculars.  
**CALLOPE**  
A silver screen wonderland of films for the little people.
- 9 BET (Black Entertainment Television)**  
Presenting quality programming featuring black performers in dominant or leading roles. Feature films, classics, music specials and sports.
- 9 C-SPAN**  
Daily live coverage of the House of Representatives.
- 10 SHOWTIME (West)**  
Range of entertainment specials expands as SHOWTIME ushers in Broadway and Off-Broadway plays. Also original made-for-pay programming, first run films, nightclub acts, and musical specials.
- 11 NICKELODEON**  
A programming playground constructed to capture the spirit and curiosity of youngsters and adolescents.
- 12 SHOWTIME (East). Same as SHOWTIME (West)**
- 13 TBN (Trinity Broadcasting Network)**  
A 24-hour package of religious programming from the Trinity Broadcasting Network.
- 14 CNN (Cable News Network)**  
Round-the-clock news service featuring top professionals from the news industry. Live financial reports from the New York Stock Exchange, same day sports coverage, weather, and a continuous variety of features.
- 16 SHOWTIME (Spore).**
- 16 ACSN (Appalachian Community Service Network)**  
Meeting the educational and cultural needs of communities throughout the country. Offering college-level and continuing education credit while viewing programs at home and providing timely topics of interest through public service programming.
- 16 VSN (Video Sports Network)**  
Sporting events from the Southeast.
- 17 WOR**  
New York's independent station featuring 700 action packed hours of sports programming, plus movies and TV shows from the past decades. (WOR-TV, New York, Channel 9.)
- 18 GALAVISION**  
The only Spanish language service offering first run feature films, novels, specials, and sporting events from Mexico, Latin America and Spain.
- 20 CINEMAX (East)**  
Designed specifically to complement HBO as a second service. All-movie service structured into time blocks according to female, children, family, or adult audience appeal.
- 21 SPN (Satellite Program Network)**  
A full entertainment network highlighted by movies, talks, celebrity shows, and music shows with public affair services, financial self-help programs, magazine news programs and syndicated series.
- 21 HTN (Home Theater Network)**  
Good, clean family entertainment featuring a solid G/PG movie package.
- 22 MODERN SATELLITE NETWORK**  
The alternative daytime television network, featuring programs and series providing information, opinion and entertainment for the general consumer.
- 22 HBO (West)**  
The industry's most popular full service compliment of first run movies, sports and entertainment specials.
- 23 CINEMAX (West). Same as CINEMAX (East).**
- 24 HBO (East). Same as HBO (West).**